

**Jefferson County School District No. R-1  
Support Services Division**

**TECHNICAL GUIDELINES**

**DIVISION 26 – Electrical**

**February 26, 2008**

## **DIVISION 26 – ELECTRICAL**

### **26 05 19 Low-Voltage Electrical Power Conductors and Cables – April 20, 2007**

- Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
- Section Includes
  1. Building wire
  2. Cable
  3. Wiring connections and terminations
- Coordination
  1. Section 07 80 00 Fire and Smoke Protection
  2. Section 26 05 53 Identification for Electrical Systems
  3. Section 26 08 00 Commissioning of Electrical Systems
  4. See Data, Communications, and Alarm Diagram
- In the absence of other information, the following standards apply:
  1. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
  2. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- Submittals
  1. Product Data: Required
  2. Closeout:
    - a. Submittals listed above, updated to record status.
    - b. Operation and Maintenance Data
- Service entrance conductors:
  1. Wire-rack conduit with State and NEC methods
- Building Wire
  1. Thermoplastic-Insulated Building Wire: NEMA WC 5.
  2. Rubber-Insulated Building Wire: NEMA WC3.
  3. Feeders and Branch Circuits 4 AWG to 250 kcmil: Copper, stranded conductor, 600 volt insulation, 75° C, THW, THHN/THWN, XHHW.
  4. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THW, THHN/THWN, XHHW. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid conductor.
  5. Feeders and Branch Circuits 250 kcmil and Larger: Copper stranded conductor, 600 volt insulation, 75° C, THHN, XHHW, THW, THWN.
  6. Control Circuits: Copper, #14 AWG, 19/25 stranding, THHN, 90° C, 600 volt. Multi-conductor control cables are allowed where more than three conductors are used between common terminations. Minimum of two spare control conductors in each cable.
  7. Wiring: #12 AWG solid, minimum, with full size ground conductors unless specifically noted otherwise for certain limited applications.
  8. 600 volt crosslinked polyethylene or thermoplastic insulated copper, 98% conductivity, single conductor.
  9. Aluminum conductors are prohibited in any application other than feeders furnished and installed by the power utility.

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- Remote Control and signal cable
  1. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 75° C, individual conductors twisted together, shielded and covered with an interlocked aluminum armor.
  2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 75° C, individual conductors twisted together shielded, and covered with a non-metallic jacket; UL listed and labeled as CL2, CL3, CL2R, CL3R, or PLTC.
  3. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 75° C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums and labeled as CL2P or CL3P.
- Armored Cable, MC Cable, ENT/NM, Modular Wire: Prohibited
- General Installation
  1. VD% less than 3% total service to end use
  2. Use no wire smaller than 12 AWG for power and lighting circuits and not smaller than 14 AWG for control wiring.
  3. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and for 20 ampere, 277 volt branch circuit home runs longer than 150 feet.
  4. Make conductor lengths equal for parallel circuits.
- Wiring installation in raceways
  1. Completely and thoroughly swab raceway system before installing conductors.
  2. Pull all conductors into a raceway at the same time. Use UL-listed wire pulling lubricant rated for - 20°F for pulling 4 AWG and larger wires.
  3. Install wire only in complete raceways after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- Support cables above accessible ceilings at four to six foot maximum intervals.
  1. Do not rest on ceiling tiles.
  2. Use hangar rods to support cables from structure.
  3. See Data, Communications, and Alarm Diagram for support details.
- Wiring connections and terminations
  1. Splice only in accessible junction or outlet boxes.
  2. Use insulated spring wire connectors with plastic caps for 10 AWG and smaller.
  3. Use U.L. listed connectors (IlSCO Clear Tap Products, or equal) for wire splices and taps, IlSCO Clear Tap or Burndy Hi Press #8-500 KCMIL
  4. Tape or heat shrink uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.
  5. Terminate spare conductors with electrical tape.
- Field Quality Control
  1. Control and signal cables passing through fire rated construction: In sleeves; conform with Technical Guideline 07 80 00 Fire and Smoke Protection.
  2. Provide sleeves for fire alarm, paging, data, telecommunications, and CATV.

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- Wire and Cable Installation Schedule
  1. Concealed Interior Locations: Building wire in raceways.
  2. Exposed Interior Locations: Building wire in raceways.
  3. Above Accessible Ceilings: Building wire in raceways.
  4. Exterior Locations: Building wire in raceways.
  5. Underground Locations: Building wire in raceways.
- Color Coding Schedule – Required for all wire sizes - full/length; factory applied
  1. 208Y/120Volt Systems:
    - a. Phase A: Black
    - b. Phase B: Red
    - c. Phase C: Blue
    - d. Neutral: White
    - e. Ground: Green
  2. 480Y/277 Volt Systems:
    - a. Phase A: Brown
    - b. Phase B: Orange
    - c. Phase C: Yellow
    - d. Neutral: Gray or white with gray striping
    - e. Ground: Green
  3. Conductors: Solid color for entire length.
  4. Conductors 8 AWG and larger: Black with color coding at each termination and in each box or enclosure.
    - a. Use 6 inches of half-lapped  $\frac{3}{4}$  inch plastic tape in the specified color.
    - b. Use of phase tape must be approved by the District.

END SECTION 26 05 19

**26 05 26 Grounding and Bonding for Electrical Systems - April 20, 2007**

- Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
- Summary
  1. Ground the main electrical service system according to the NEC.
  2. Provide Concrete Encased Electrode (UFER).
  3. See Data, Communications, and Alarm Diagram for details.
- Section Includes
  1. Power system grounding.
  2. Communication system grounding.
  3. Electrical equipment and raceway grounding and bonding.
- Submittals
  1. Shop Drawing: Required
    - a. Indicate locations of system grounding electrode connections and routing of grounding electrode conductors
  2. Closeout: Submittals listed above, updated to record status.
- Materials Summary
  1. Ground Rods: Copper-encased steel, 3/4 inch diameter, minimum length 10 feet

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- Execution Summary
  1. Ground each separately-derived system neutral as required i.e., steel structure; use or provide Burndy QGFL34B1 termination.
  2. The electrode should be terminated to XO before bonding to the transformer case.
  3. Provide communications system grounding conductor according to the Data, Communications, and Alarm Diagram.
  4. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connections, potable cold water supply, fire sprinkler main, and natural gas lines.
  5. All neutrals and grounds to comply with NEC via continuous conductor.
- Installation
  1. Provide a separate, insulated equipment grounding conductor in all feeder and branch circuits. Feeders require ground bushing, all ends.
    - a. Terminate each end on a grounding lug, bus or bushing.
    - b. Ground to all boxes unless otherwise specified
  2. Use conduit grounding bushings on feeder circuits, flex conduits to transformers and panels.
    - a. Motors:
      - (1) Both ends all splice and pull boxes
      - (2) Provide bonding bushings on feeders all ends, including motors, motor controls, disconnected TVSS, VFD drives.
  3. To establish the grounding electrical system, connect grounding electrode conductors to each of the following:
    - a. Metal potable cold water and fire sprinkler main pipe using a suitable ground clamp on the service side of the building shutoff valve. Provide and label a bonding jumper around the water meter.
    - b. Steel structure where effectively grounded.
    - c. Concrete-encased electrode per NEC 250.52 (3).
  4. Supplementary Grounding Electrode:
    - a. Use driven ground rods in main electrical room.
    - b. Install ground rod in suitable recessed well; fill with gravel after connection is made.
    - c. Use effectively grounded steel structure of the building.
  5. Use minimum 4 AWG copper conductor for communications service grounding conductor.
    - a. Insulated from building
    - b. Terminate to approved grounding bus.
    - c. See Data, Communications, and Alarm Diagram.
  6. All conduit and raceways shall contain an insulated ground wire sized per NEC 250.122
  7. Provide grounding and bonding at utility company's metering equipment and in accordance with utility company's requirements.

END SECTION 26 05 26

**26 05 29 Hangers and Supports for Electrical Systems - April 20, 2007**

- Work in this section is open to any product or material.
- Section Includes
  1. Conduit and equipment supports.
  2. Fastening hardware.
- Coordination
  1. Division 03 - Concrete pads for electrical equipment
  2. See Data, Communications, and Alarm Diagram.
- Submittals
  1. Product Data: Required
  2. Shop Drawing: Required
  3. Closeout: Submittals listed above, updated to record status.
- Support Channel: Galvanized or painted steel.
- Conduit Supports
  1. Clamps, straps, supports: Steel or malleable iron
  2. Galvanized straps, lay-in adjustable hangers, clevis hangers or bolted split stamped galvanized hangers
  3. Perforated pipe strap is prohibited.
  4. Wire of any type is prohibited.
  5. Arrange to prevent distortion or misalignment from wire pulling.
  6. Spacing: Per NEC, but in no case more than 2" from panels, boxes, conduit bodies; 8 feet-0 inches o.c.
- Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance.
  1. Hardware: Corrosion resistant.
- Secure transformers and switchgear to floor or slab
  1. Under distribution switchboards, install free-standing electrical equipment on 4 inch concrete pads.
- Install surface-mounted cabinets, panelboards, and transformers with minimum of four anchors.
  1. Align tops of all adjacent cabinets.
- Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- Fasteners
  1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or preset inserts.
  2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls.
  3. Use expansion anchors or preset inserts in solid masonry walls
  4. Use self-drilling anchors or expansion anchor on concrete surfaces
  5. Use sheet metal screws in sheet metal studs.
  6. Use hexagon head bolts with spring lock washers under all nuts.
  7. Powder-actuated anchors are prohibited without specific written permission.

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- Quality Control
  1. Fasten supports directly to structure. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling system suspension wires or wire of any type.
  2. Drilling or other modification of structural steel members is prohibited without specific written permission from the structural engineer.

END SECTION 26 05 29

**26 05 33 Raceway and Boxes for Electrical Systems – April 20, 2007**

- Coordination
  1. Division 08 - Access Doors: Wall and ceiling access doors.
  2. Section 26 05 53 Identification for Electrical Systems.
  3. Section 26 27 16 Electrical Cabinets and Enclosures.
  4. Section 26 27 26 Wiring Devices: Service fittings and fire-rated poke-through fittings for floor boxes.
  5. Trenching: Division 31
  6. Roof penetrations are prohibited unless coordinated and detailed in strict compliance with Division 07.
  7. Coordinate exposed and surface mounted runs with Architect prior to rough-in.
  8. See Data, Communications, and Alarm Diagram.
- In the absence of other information, the following standards apply:
  1. ANSI/EMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
  2. NEMA 250 Enclosures for Electrical Equipment (1000 volts maximum).
  3. ANSI C80.1 Rigid Steel Conduit, Zinc Coated
  4. ANSI C80.3 Electrical Metallic Tubing, Zinc Coated
  5. ANSI/NEMA FB 1 Fittings and Supports for Conduit and Cable Assemblies
  6. NEMA RN 1 PVC Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
  7. NEMA TC 2 and TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing
- Applications
  1. Underground installations more than 5 feet from foundation wall:
    - a. Rigid Metal Conduit
    - b. Intermediate Metal Conduit
    - c. Plastic coated Rigid steel conduit
    - d. Schedule 40 PVC conduit
  2. Underground installations within 5 feet of foundation wall or in or under concrete slab:
    - a. Rigid Metal Conduit
    - b. Intermediate Metal Conduit
    - c. Plastic coated rigid steel conduit
    - d. Schedule 40 PVC conduit

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3. Exposed outdoor locations
  - a. Rigid Metal Conduit (GRC) 0-4'
  - b. Intermediate Metal Conduit 0-4'
  - c. Electrical Metallic Tubing 4' - +
4. Wet interior locations
  - a. Rigid Metal Conduit 0-4'
  - b. Intermediate Metal Conduit 0-4'
  - c. Electrical Metallic Tubing 4' - +
5. Concealed dry interior locations
  - a. Rigid Metal Conduit
  - b. Intermediate Metal Conduit
  - c. Electrical Metallic Tubing
6. Exposed dry interior locations
  - a. Rigid Metal Conduit (GRC) 0-4'
  - b. Intermediate Metal Conduit 0-4'
  - c. Electrical Metallic Tubing 4' - + (AFF and AFG) Applies to all.
- Restrictions
  1. Attachment of conduit and tubing to any exterior part of the building envelope is prohibited without the approval of Jefferson County School District, R-1 and compliance with Division 07 of these Technical Guidelines.
  2. Horizontal conduit runs within above grade concrete slabs are prohibited.
- Submittals
  1. Product Data: Required for surface raceways, multi-outlet assemblies, auxiliary gutters, and accessories.
  2. Shop Drawing: Required
  3. Closeout: Submittals listed above, updated to record status.
- Wall and ceiling outlet boxes
  1. Open to any product or material.
  2. Sheet Metal Outlet Boxes:
    - a. ANSI/NEMA OS 1;
    - b. Galvanized steel, with 1/2 inch male fixture studs where required.
    - c. Standard size for all systems: 4 inches x 4 inches x 2 1/8 inch minimum depth
  3. Cast Boxes: Aluminum, deep type, gasketed cover, threaded hubs.
- Pull and Junction Boxes
  1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
    - a. Appleton Electric
    - b. Bowers
    - c. Carlton
    - d. Lew Electric
    - e. National Electrical Products
    - f. Raco
    - g. Steel City
  2. Sheet Metal Boxes less than 24 inches: ANSI/NEMA OS 1; galvanized steel.
  3. Sheet Metal Boxes Larger than 24 inches in any dimension: Hinged enclosure in accordance with Section 26 27 16.

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4. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Cast aluminum box and cover with ground flange, neoprene gasket and stainless steel cover screws.
5. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Cast aluminum box and plain cover with neoprene gasket and stainless steel cover screws.
  - a. Traffic rated where required
6. Fiberglass Handholes for Underground Installations:
  - a. Die-molded with pre-cut 6 x 6 inch cable entrance at center bottom of each side
  - b. Fiberglass weatherproof cover with non-skid finish
7. Locate and install boxes above accessible ceilings or in unfinished areas to allow access.
  - a. Where installation is inaccessible, coordinate locations and size of required access doors.
  - b. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
8. Locate and install boxes to maintain headroom and to present a neat appearance.
9. Support pull and junction boxes independent of conduit.
- Floor Boxes
  1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
    - a. Appleton Electric
    - b. Bowers
    - c. Hubbell
    - d. Lew Electric
    - e. Raceway Components Inc.
    - f. Rotco Inc.
    - g. Steel City
    - h. Walker
- Outlet Boxes
  1. Open to any product or material.
  2. Do not install boxes back-to-back in walls.
    - a. Provide minimum 6 inch separation; 24 inch separation in acoustic or fire-rated walls.
  3. Locate boxes in masonry walls to require cutting of masonry unit corner only.
  4. Provide knockout closures for unused openings.
  5. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box.
  6. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes.
  7. Provide barriers to separate wiring of different voltage systems.
  8. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

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9. Provide cast outlet boxes in exterior locations exposed to the weather and wet interior locations.
10. Exposed boxes in kitchens and shops:
  - a. Provide bell type boxes with threaded openings.
- **Underground Pull Boxes**
  1. Restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department:
    - a. Amcor 3 x 3 precast PB 3030-30; #0300720
- **Underground Ducts and Raceways**
  1. Open to any product or material.
- **Rigid Metal Conduit and Fittings**
  1. Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
  2. Rigid Steel Conduit: ANSI C80.1 galvanized
  3. PVC Externally Coated Conduit: NEMA RN 1 Rigid steel conduit with external 40 mil PVC coating and internal galvanized surface
  4. Fittings and Conduit Bodies: ANSI/NEMA FFB 1; Threaded type, material to match conduit
- **Intermediate Metal Conduit and Fittings**
  1. Open to any product or material.
  2. Conduit: Galvanized steel
  3. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Threaded type, material to match conduit
- **Electrical Metallic Tubing and Fittings**
  1. Open to any product or material meeting the requirements of this Technical Guideline.
  2. EMT: ANSI C80.3 Galvanized tubing
  3. Fittings: ANSI/NEMA FB 1; High quality, insulated throat, steel set screw
    - a. Die cast fittings are prohibited
  4. Steel Compression Fittings: High quality compression is required on surface work in kitchens, greenhouses, and other areas where waterproof fittings are required by NEC
  5. Conduit Bodies: Aluminum, steel or malleable iron
    - a. PVC is prohibited
- **Flexible Metal Conduit and Fittings**
  1. Open to any product or material.
  2. Conduit: Steel
  3. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Material to match conduit
  4. Length: 6 feet maximum except where fished or approved by NEC and Jefferson County School District, R-1.
- **Liquid Tight Flexible Metal Conduit and Fittings**
  1. Open to any product or material.
  2. Conduit: Flexible metal conduit with PVC jacket
  3. Fittings and Conduit Bodies: ANSI/NEMA FFB 1; waterproof material to match conduit.

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- Non-Metallic Conduit and Fittings
  1. Open to any product or material
  2. Conduit: NEMA TC 2; Schedule 40 PVC
  3. Fittings and Conduit Bodies: NEMA TC 3
  4. Prohibited for exposed or concealed applications in stud and masonry walls or ceiling plenum.
  5. Wipe plastic conduit clean and dry before joining
  6. Apply full even coat of cement to entire area that will be inserted into the fitting
  7. Cure joint 20 minutes minimum
  8. Transition between PVC and metal conduit below grade or within slab.
- Surface Metal Raceways
  1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1:
    - a. Carlton
    - b. Hubbell
    - c. IsoDuct
    - d. Panduit
    - e. Square D
    - f. Walker
    - g. Wiremold
  2. Sheet metal channel with fitted cover suitable for use as surface metal raceway
  3. Couplings, elbows and connectors designed for use with the raceway system
  4. Boxes and Extension Rings designed for use with the raceway systems
    - a. Extension boxes and/or rings not allowed on new work
  5. Use flat head screws to fasten channel to surfaces
    - a. Option: Use suitable clips and straps
  6. Use insulating bushings and inserts at connections to outlets and corner fittings
  7. Maintain grounding continuity between raceway components
  8. Preferred location: below the work surface or deck tops
- Multi-Outlet Assembly
  1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department:
    - a. Carlton
    - b. IsoDuct
    - c. Panduit
    - d. Pass & Seymour
    - e. Walker
    - f. Wiremold
  2. Multi-outlet Assembly: channel with fitted cover and pre-wired receptacles, suitable for use as a multi-outlet assembly.
  3. Convenience receptacles mounted in cover at designated intervals.
  4. Couplings, elbows, outlet and device boxes and connectors designed for use with multi-outlet system.
  5. Use flat head screws to fasten channel to surfaces
    - a. Option: Use suitable clips and straps

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6. Use insulating bushings and inserts at connections to outlets and corner fittings
7. Maintain grounding continuity between raceway components
8. Preferred location: Below the work surface or deck tops
- Auxiliary Gutters
  1. Open to any product or material.
  2. General purpose type wireway, with knockout
  3. Connector: Hinged cover, screw applied cover.
  4. Lay-in type fittings with removable top, bottom, and side; captive screws.
  5. Rust inhibiting primer coat with gray enamel finish.
  6. Bolt auxiliary gutter to steel channels fastened to the wall or in self-supporting structure.
  7. Install level
  8. Gasket each joint in oil-tight gutter.
  9. Mount raintight gutter in horizontal position only.
- Accessories
  1. Open to any product or material.
  2. Conduit Rack: steel channel with conduit straps or clamps; Oversize by 25%
- Conduit Size
  1. Size conduit for installed conductor type or for type THW conductors, whichever is larger.
  2. ½ inch minimum except flexible fixture whips which may be 3/8 inch
  3. Home runs to switchboards and panels: 3/4 inch minimum
- General Installation Requirements
  1. Conceal conduit to the greatest extent possible
  2. Run conduit parallel and perpendicular to adjacent walls, ceilings, piping, exposed and concealed.
  3. Maintain 6 inch minimum clearance between conduit and piping.
  4. Maintain 12 inch minimum clearance between conduit and heat sources such as flues, pipes, and heating appliances.
  5. Group conduit in parallel runs where practical. Conduit Rack is preferred.
  6. Remove temporary conduit supports before pulling conductors
  7. Exposed interior locations
    - a. Mount conduit at underside of metal deck
- Special Installation Techniques
  1. Bring conduit to the shoulder of fittings and couplings.
  2. Fasten securely
  3. In damp or wet locations, use conduit hubs or sealing locknuts for fastening conduit to cast boxes and to fasten conduit to sheet metal boxes.
  4. Use conduit bodies to make sharp changes in direction, as around beams
  5. Use hydraulic one shot conduit bender or factory elbows for bends in conduit larger than 2 inch size
  6. Avoid moisture traps. Where unavoidable, provide junction box with drain fitting at conduit low point
  7. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture
  8. Use nylon pull string ("jetline") with at pull strength of 200 pounds or greater in empty conduits except sleeves and nipples.

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9. Use PVC coated rigid steel factory elbows
  - a. For bends in plastic conduit runs longer than 100 feet
  - b. In plastic conduit runs which have more than 2 bends, regardless of length
- Interface with other work
  1. Install expansion joints where conduit crosses building expansion joints.
  2. Where conduit penetrates fire rated construction, provide pipe sleeves 2 sizes larger than conduit. Conform with Technical Guideline 07 80 00 Fire and Smoke Protection.
- Underground and Concrete Encased Conduit
  1. Install conduit 24 inches minimum below finished grade unless otherwise authorized by Jefferson County School District, R-1
  2. Minimum slope: 4%
  3. Minimum size: 3/4 inch
  4. Use suitable separators and chairs installed no more than 4 feet 0 inches o.c. and securely anchor conduit to prevent movement during placement of concrete
  5. Provide minimum 3 inch concrete cover at top, bottom, and sides of conduit.
  6. Seal ends to be completely water tight
- Raceway for telephone, television, paging, and local area network.
  1. Conduit runs less than 100 feet from point-to-point shall not contain more than two 90° standard factory bends, or three 90° , 24 inch radius bends.
  2. Conduit runs exceeding 100 feet from point-to-point or exceeding two 90° - 24” radius bends shall contain accessible pull boxes.

END SECTION 26 05 33

**26 05 53 Identification for Electrical Systems – April 20, 2007**

- Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
- Nameplates, markers, or labels are required at each and every component of the electrical system.
- Coordination
  1. Section 09 90 00 – Painting and Coating
  2. See Data, Communications, and Alarm Diagram.
- Submittals
  1. Product Data: Required
  2. Shop Drawing: Required; Include complete schedule of nameplates and labels.
  3. Samples: Required
  4. Closeout: Submittals listed above, except samples, updated to record status.
- Fonts for all identification
  1. Sans Serif typeface such as Helvetica
- Nameplates:
  1. Provide engraved nylon trim plates for gym lighting corridor and boxes three (3) gang and larger.
  2. Distribution and control equipment
    - a. Engraved three-layer laminated plastic
    - b. Identify equipment and loads served.
    - c. 1/8 inch lettering for individual switches and loads served

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- d. 1/4 inch lettering for distribution and control equipment.
3. Panelboards and Switchboards:
  - a. 1/4 inch lettering to identify equipment designation
  - b. 1/8 inch lettering to identify voltage rating and source.
4. Individual Circuit Breakers and Switches in Panelboards and Switchboards:
  - a. 1/8 inch lettering to identify circuit and load served, including location.
5. Individual Circuit Breakers, Enclosed Disconnect Switches, and Motor Starters:
  - a. 1/8 inch lettering to identify load served.
6. Transformers:
  - a. 1/4 inch lettering to identify equipment designation.
  - b. 1/8 inch lettering to identify primary and secondary voltages, primary source, and secondary load and location.
7. Main Grounds:
  - a. 1/4 inch lettering "Do Not Disconnect". 1/4 inch lettering to identify type of ground.
8. Data/Communications: No requirements at this time.
- Color Code
  1. Black characters on white or clear background for "Normal",
  2. White characters on red background for "Emergency" and fire alarm devices
  3. White characters on green background for "Ground".
- Printed, Laminated Labels:
  1. Self-adhesive, thermal transfer tape
  2. Minimum 3/8 inch high characters
  3. Colors as noted in color code above
  4. Use only for identification of individual wall switches and receptacles, control device stations.
  5. Locate tape on back side of the coverplate.
- Wire and Cable Markers:
  1. Permanently printed split sleeve tube type adhesive backed circumferential: Brady
- Degrease and clean surfaces to receive nameplates and tape labels.
- Install nameplates and tape labels parallel to equipment lines.
  1. Secure nameplates to equipment fronts using screws, rivets.
  2. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- Label "Grounding Electrode Conductor" and "Main Bonding Jumper" with engraved tags.
- Wire Identification
  1. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection.
  2. Identify with branch circuit or feeder number as indicated on equipment manufacturer's shop drawings for control wiring.
- Junction Box and Pull Box Identification
  1. Use indelible black marker to inscribe circuit or bus, switch numbers and source panel on the outside of each junction and pullbox cover.
- Systems Identification
  1. Telephone:
    - a. Identify telephone raceways with the label "TELEPHONE" on pull and junction boxes and conduit at the termination points.

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- b. Identify Telephone Termination Backboard with the legend “TELEPHONE” on pull and junction boxes and conduit at the termination points.
2. Television: Identify television raceways with the label “TELEVISION” on pull and junction boxes and conduit at the termination points.
3. Label outlets and switches in front with printed labels, back of plate use indelible ink.

END SECTION 26 05 53

**26 08 00 Commissioning of Electrical Systems – April 20, 2007**

- Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
- Testing is required for all Division 26 equipment, wiring, devices, etc. to assure that electrical equipment is operational within industry and manufacturer's tolerances and conforms to the contract documents.
- In the absence of other information, standards of the following organizations apply:
  1. National Electrical Testing Association, Inc. - NETA.
  2. Association of Edison Illuminating Companies - AEIC.
- Submittals
  1. Documentation of Testing Agency accreditation: Required
  2. Written Test Reports: Required
    - a. Preliminary
    - b. Certified Final Test Reports
  3. Closeout: Submittals listed above, updated to record status.
- Testing Equipment
  1. All instruments used to evaluate electrical performance shall meet NETA's Specifications for Test Instruments.
    - a. The Contractor shall have a calibration program which maintains each applicable test instrument within its rated accuracy.
  2. Instruments shall be calibrated in accordance with the following frequency schedule:
    - a. Field instruments - 6 months maximum.
    - b. Laboratory instruments - 12 months.
    - c. Leased specialty equipment - 12 months (Where accuracy is guaranteed by lessor, i.e. Doble).
  3. Dated calibration labels shall be visible on all test equipment.
  4. Maintain an up-to-date instrument calibration instruction for each test instrument.
  5. Maintain up-to-date documentation showing date and results of instrument calibration and testing.
- Acceptable Testers
  1. Any independent testing laboratory meeting federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the National Electrical Testing Association constitutes proof of meeting such criteria.
  2. Electrical subcontractor unless otherwise noted.
- Testing Schedule
  1. Cables - Low Voltage (600 Volts and less – Electrical Systems Only)
    - a. Visual and Mechanical Inspection
      - (1) Inspect cables for physical damage and proper connection in accordance with

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- the engineer's single line diagram.
- (2) Torque test each feeder cable connection to the manufacturer's recommended value.
  - (3) Branch circuits excluded.
- b. Electrical Tests
- (1) Prior to final wire termination perform an insulation resistance test on each feeder cable (branch circuit wires are excluded) with respect to ground and adjacent cables.
  - (2) Perform continuity test to insure proper cable connection.
  - (3) Test Values: Insulation resistance tests shall be performed at 1000 volts D.C. for 30 seconds. Minimum resistance value: 250,000 ohms.
2. Circuit breakers - low voltage
- a. Visual and Mechanical Inspection
- (1) Check each circuit breaker for proper mounting, conductor size and feeder designation.
  - (2) Operate each circuit breaker to insure smooth operation.
  - (3) Inspect each case for cracks or other defects.
  - (4) Check tightness of each connection with torque wrench in accordance with manufacturer's recommendations.
3. Grounding Systems
- a. By independent testing laboratory only
- b. Visual and Mechanical Inspection
- (1) Inspect ground system for compliance with plans and specifications.
- c. Electrical Tests:
- (1) Perform fall of potential test per IEEE Standard No. 81, Section 9.04, on the main grounding electrode or system.
  - (2) Perform the two point method test per IEEE No. 81, Section 9.03 to determine the ground resistance between the MDCs and SDPs.
  - (3) Test Values: The main ground electrode system resistance to ground should be no greater than 5 ohms.
4. Ground Fault Systems (NEC 230-95)
- a. By independent testing laboratory only
- b. Visual and Mechanical Inspection:
- (1) Inspect for physical damage and compliance with plans and specifications.
  - (2) Inspect neutral main bonding connection to assure:
    - (a) Zero sequence system is grounded upstream of sensor.
    - (b) Ground strap systems are grounded through sensing device.
    - (c) Ground connection is made ahead of neutral disconnect link.
  - (3) Inspect control power transformer to insure adequate capacity for system.
  - (4) Manually operate monitor panels (if present) for:
    - (a) Trip test.
    - (b) No trip test.
    - (c) Non-automatic reset.
  - (5) Record the proper operation and test sequence.

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- (6) Inspect zero sequence systems for symmetrical alignment of core balance transformers about all current carrying conductors.
  - (7) Verify ground fault device circuit nameplate identification by device operation.
  - (8) Set pickup and time delay values in accordance with those provided by the engineer.
  - (9) Set main switch GFI to job-specific values.
  - (10) Do not leave at factory minimum setting.
3. Electrical Test:
- (1) Remove the neutral-to-ground connecting link to measure the neutral insulation resistance and insure that no shunt ground paths exist. Replace the link.
  - (2) Determine the relay pickup current.
  - (3) Test system operation at 125% rated voltage.
  - (4) Test Parameters:
    - (a) System neutral insulation shall be a minimum of one megohm or greater.
    - (b) Relay pickup current: Within 10% of device dial or fixed setting and in no case greater than twelve hundred amperes.
    - (c) Relay timing: In accordance with manufacturer's published time current characteristic curves but in no case longer than one second.
- See Division 27 for testing requirements of communication and alarm systems.

END SECTION 26 08 00

**26 22 00 Low Voltage Transformers – April 20, 2007**

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
  1. General Electric
  2. Howard Industries
  3. International Transformer Corporation
  4. ITE
  5. Square D
  6. Cutler Hammer/Eaton
- In the absence of other information, the following standards apply:
  1. ANSI/NEMA ST 20 – Dry Type Transformers for General Applications.
- Submittals
  1. Product Data: Required
  2. Manufacturer's specification and product data cut sheets for all system components and devices, including:
    - a. Outline and support point dimensions of enclosures and accessories
    - b. Unit weight
    - c. Voltage, KVA, impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load,
    - d. Sound level, tap configurations, insulation system type and rated temperature rise.
  3. Manufacturer Instructions: Required
  4. Closeout: Submittals listed above, updated to record status.

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- Coordination
  1. See Data, Communications and Alarm Diagram
- Dry type dual winding Transformers
  1. ANSI/NEMA ST 20; factory-assembled, air cooled dry type transformers
  2. Insulation system and average winding temperature rise for rated KVA as follows:
    - a. Rating K-Rated Transformer Rise (°C)
  3. Case temperature shall not exceed 35°C rise above ambient at its warmest point.
  4. Winding Taps for Transformers Less than 15 KVA: Two, 5 percent below rated voltage, full capacity taps on primary winding.
  5. Winding Taps for Transformers 15 KVA and Larger: Six 2.5% taps, 2 above and 4 below rated high voltage; ANSI/NEMA ST 20. Sound Levels: Minimum 3 dBA less than NEMA ST20 standard sound level when factory tested according to IEEE Standard (57.12.91), “Test Code for Dry Distribution and Power Transformers”:

<u>KVA Rating</u>	<u>Sound Level</u>
0 - 9	40 db
10 - 50	45 db
51 - 150	50 db
151 - 300	55 db
301 - 500	60 db
750	64 db
  6. Basis Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger.
  7. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
  8. Coil Conductors: Continuous copper primary and secondary windings with terminations brazed or welded.
  9. Enclosure: ANSI/NEMA ST 20; Type 1.
  10. Provide lifting eyes or brackets
- 3 Phase Transformers
  1. Delta Primary
  2. Y Secondary
- Mounting
  1. Transformers: 30 KVA and smaller
    - a. Floor mounting preferred
    - b. Wall or trapeze mounting permitted
  2. Transformers larger than: 45 KVA and larger
    - a. Floor mounting required
  3. Transformers are prohibited within plenums and above ceilings.
  4. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
    - a. Provide seismic restraints.
- Installation
  1. Connect to transformer case with flexible conduit, 2 feet minimum; 4 feet maximum length with grounding bushing
    - a. Make conduit connections to side panel of enclosure.
    - b. Liquid tight or seal tight is required.
    - c. Bonding bushings both ends

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- Field Quality control
  1. Check for damage and tight connections prior to energizing transformer
  2. Measure primary and secondary voltages and make appropriate tap adjustments.

END SECTION 26 22 00

**26 24 00 Switchboards and Panelboards – April 20, 2007**

- Work in this section is restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1.
  1. Cutler Hammer/Eaton/Westinghouse
  2. General Electric
  3. Square D
  4. Siemens
- A single manufacturer per project or facility is required for all items specified in this section
- Coordination
  1. See Data, Communications and Alarm Diagram.
- Section Includes
  1. Main Service switchboards
  2. Distribution switchboards
  3. Disconnect switches
  4. Lighting and appliance branch circuit panelboards
  5. Molded Case Circuit Breakers
  6. Switch enclosures
- References
  1. In the absence of other information, the following standards apply:
    - a. ANSI C12 - Code for Electricity Metering.
    - b. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments.
    - c. ANSI C57.13 - Requirements for Instrument Transformers.
    - d. NEMA KS 1 - Enclosed Switches.
    - e. NEMA PB 2 - Dead Front Distribution Switchboards.
    - f. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operating and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
    - g. NEMA AB 1 - Molded Case Circuit Breakers.
    - h. NEMA PB 1 - Panelboards.
    - i. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
    - j. NEMA KS 1 - Enclosed Switches.
- Submittals
  1. Product Data: Required
  2. Shop Drawing: Required
    - a. Include detailed front and side views of enclosures with overall dimensions; Conduit entrance locations and requirements; Nameplate legends (including short circuit bracing of bus structures); Size and number of bus bars for each phase, neutral and ground; Switchboard instrument details; Instructions for handling and installation of switchboard; Electrical characteristics including voltage, frame

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- size, trip ratings and time-current curves of all equipment and components; and ratings and descriptions for all main, submain and distribution circuits.
- b. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower and short circuit.
  3. Manufacturer Instructions: Required
  4. Design Data, Test Reports, Certificates, Manufacturers Field Reports
    - a. Outline and support point dimensions
    - b. Voltage, phase, wires (busses), main bus ampacity, main circuit breaker ampacity (where applicable) and integrated short circuit ampere ratings
    - c. Include branch circuit breaker arrangement and sizes in a panelboard schedule format.
    - d. Installation Instructions
  5. Closeout:
    - a. Submittals listed above, updated to record status
    - b. Operation and Maintenance Data including spare parts list and the recommended maintenance procedures and intervals
    - c. Extra Materials: Furnish three keys for each differently keyed panelboard.
  - Switchboard construction and ratings
    1. Factory-assembled, dead front, metal enclosed and self-supporting switchboard assembly conforming to NEMA PB2 and complete from incoming line terminals to load-side terminations
    2. Line Terminations: Accessible from the front of the switchboard and suitable for the conductor material (copper) used
    3. Main Section Devices: Individually mounted and compartmented
    4. Distribution Section Devices: Panel mounted
    5. Auxiliary Section Devices: Individually mounted and compartmented
    6. Bus Material: Copper only and sized in accordance with NEMA PB 2
    7. Bus Connections: Bolted, accessible for maintenance
    8. Horizontal bus feeding sub-sections shall be fully rated.
    9. Bus bars shall be non-tapered throughout with bus spacing based on air insulation.
      - a. Insulation: poly-fiber material.
      - b. Cable splicing bus sections are prohibited
      - c. Buss all switchboard sections for the full height of the structure.
    10. Provide a minimum 1 x 1/4-inch copper ground bus through the length of the switchboard.
    11. Enclosure: NEMA PB 2 Type 1, General Purpose.
      - a. Sections shall align at front and rear.
    12. Switchboard Height: NEMA PB2, 90 inches excluding floor sills, lifting members and pull boxes
    13. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint or plate with cadmium or zinc.
    14. Pull Section: Same construction as switchboard, 30 inch width, depth and height to match switchboard
    15. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Continuous current rating

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- Switching and overcurrent protective devices
  1. Breaker or Switch Fuse criteria: Per electrical engineer
  2. Provide 25% spare spaces for future loads.
  3. Fusible Switch Assemblies Through 600 Amperes:
    - a. NEMA KS 1 quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle.
    - b. Provide interlock to prevent opening front cover with switch in ON position.
    - c. Handle lockable in OFF position.
    - d. Fuse Clips: Designed to accommodate Class R fuses.
  4. Fusible Switch Assemblies, 800 Amperes and Larger:
    - a. Bolted pressure contact switches.
    - b. Fuse Clips: Designed to accommodate Class L fuses.
    - c. Provide with electric trip and integral ground fault and blown fuse sensing and trips where required.
- Ground Fault
  1. Ground Fault Sensor: Zero sequence type.
  2. Ground Fault Relay:
    - a. Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Final setting by electrical engineer, not left at factory setting
    - b. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- Lighting and appliance branch circuit Panelboards
  1. NEMA PB1; circuit breaker type.
  2. Enclosure: NEMA PB 1; Type 1.
  3. Minimum Cabinet Size: 6 inches deep; 20 inches wide for 480 volt and less panelboards.
  4. Flush or surface cabinet front with door and hinged cover construction, concealed trim clamps, concealed hinge and flush lock all keyed alike
    - a. Also applies to large SDP panels
  5. Finish: Manufacturer's standard gray enamel.
  6. Construct adjacent panels to the same size; The largest section shall therefore determine the physical size of the remaining panels.
  7. Copper bus rated as scheduled on Panel Board Schedules.
  8. Copper ground bus.
  9. Extend vertical bussing the full height of the panelboards.
  10. Minimum of 50% spare spaces with reasonable spare capacity.
  11. Height: 6 feet.
  12. Filler plates for unused spaces in panelboards.
- Molded Case Circuit Breakers:
  1. NEMA AB 1 bolt-on type thermal magnetic trip circuit breakers with common trip handle for all poles.
  2. Circuit breakers UL listed as:
    - a. Type SWD for lighting circuits.
    - b. Type HID for high intensity discharge lighting circuits
  3. UL Class A ground fault interrupter circuit breakers
    - a. Stab or push-in style breakers are prohibited

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- Provide typed circuit directory for each branch circuit panelboard.
- Disconnect Switches
  1. NEMA Type 1: Indoors in dry locations.
  2. NEMA Type 3R: For outdoors as required by the NEC or where "weatherproof" (wp) is required
  3. Bonding bushings mandatory all feeders
- Fusible Disconnect Switch Assemblies:
  1. NEMA KS 1; Type heavy duty (HD); quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position.
  2. Handle lockable in OFF position.
  3. Fuse clips designed to accommodate Class R fuses.
- Nonfusible Disconnect Switch Assemblies:
  1. NEMA KS 1; Type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position.
  2. Handle lockable in OFF position.
  3. Fractional Horsepower Motors: Horsepower rated thermal overload switches or manual motor starters.
  4. Provide ground bus.
  5. Provide neutral bus where called for
  6. Switches used as service entrance equipment shall be U.L. SE labeled.
- Switchgear and Switchboard Assemblies General
  1. Visual and Mechanical Inspection:
    - a. Inspect for physical damage
    - a. Compare equipment nameplate information with latest single line diagram and report discrepancies.
    - b. Inspect for proper alignment, anchorage and grounding.
    - c. Check tightness of bolted bus joints.
    - d. Check that gear is firmly attached to floor or wall.
    - e. Inspect all doors, panels and sections for damaged paint, dents, scratches and proper fit.
  2. Electrical Tests:
    - a. Insulation Resistance Test: Measure the insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute. Use the manufacturers' recommended test voltages and the minimum acceptable resistance values.
    - b. Test Values: Bolt torque levels shall be in accordance with values specified by manufacturer.
- Transformers – dry type
  1. Visual and Mechanical Inspection:
    - a. Inspect for physical damage
    - b. Compare equipment nameplate information with the engineer's latest single line diagram.
    - c. Check tightness of accessible bolted electrical joints
    - d. Specific inspections and mechanical tests as recommended by manufacturer.
  2. Electrical Tests:
    - a. Insulation resistance tests shall be performed winding-to-winding and winding-to-

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- ground. Appropriate guard circuit shall be utilized under all bushings.
- b. Winding resistance tests shall be made for each winding at the nominal tap position.
  - c. Test values: Insulation resistance test voltage, temperature corrected
- Execution Summary
    1. Install switchboards on 4 inch high concrete housekeeping pad.
    2. Bolt switchboard to floor or wall.
    3. Stub five empty 1 inch conduits to accessible location above ceiling out of each recessed panelboard.
    4. Circuit Directory: Revise directory to reflect circuiting changes required to balance phase loads.
      - a. Note spare circuits in pencil.
    5. Ground bushing feeder conduit only; Required – both sides of all transitions.
    6. Neatly train and tie wrap conductors.
    7. Remove all debris.

END SECTION 26 24 00

**26 27 16 Electrical Cabinets and Enclosures – April 20, 2007**

- Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
- In the absence of other information, the following standards apply:
  1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum.)
  2. ANSI/NEMA ICS 1 - Industrial Control and Systems.
  3. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
  4. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment and Systems.
- Coordination
  1. See Data, Communications, and Alarm Diagram
- Submittals
  1. Product Data: Required
  2. Shop Drawing:
    - a. Cabinets: Include dimensioned plan and elevation, front and side views and any other pertinent elevation views; knock-out or punching information.
    - b. Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.
  3. Closeout: Submittals listed above, updated to record status.
- Hinged cover enclosures
  1. Construction: NEMA 250; Type 1, steel.
  2. Components: 14 gage steel, white enamel finish.
  3. Finish: Manufacturer's standard enamel finish.
  4. Covers: Continuous hinge, held closed by flush latch operable by key.
  5. Panel for Mounting Terminal Blocks or Electrical
- Cabinets
  1. Cabinet Boxes: Galvanized steel with removable endwalls, 24 inches wide, 6 inches deep.

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2. Cabinet Fronts: Steel, surface type with concealed hinge and flush lock keyed separately for each system; finish in gray baked enamel.
- Terminal blocks and accessories
  1. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.
  2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
  3. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.
- Provide 3/4 inch thick fire rated plywood backboard for mounting cabinet terminal blocks. Do not paint.
- Fabrication
  1. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
  2. Provide knockouts on enclosures.
  3. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosures.
- Execution Summary
  1. Install cabinets, enclosures, and trim plumb.
  2. Anchor securely to wall and structural supports at each corner, minimum.
  3. Provide accessory feet for free-standing equipment enclosures.

END SECTION 26 27 16

**26 27 26 Wiring Devices – April 20, 2007**

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
  1. Provide samples before installation.
    - a. Arrow Hart
    - b. Bryant
    - c. Eagle
    - d. Hubbell
    - e. Leviton
    - f. Lutron
    - g. Pass & Seymour
  2. Floor mounted service fittings:
    - a. Raceway Components
  3. Cord Drops:
    - a. Daniel Woodhead
- In the absence of other information, the following standards apply:
  1. NEMA WD 1 - General-Purpose Wiring Devices.
  2. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.
  3. NEMA WD 5 - Specific-Purpose Wiring Devices.
- Submittals
  1. Product Data: Required. Include configurations, finishes, and dimensions.
  2. Manufacturer Instructions: Required

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3. Closeout: Submittals listed above, updated to record status.
- Coordinate wiring connections, cords and caps with:
  1. Section 01 64 00 – Owner supplied products.
  2. Section 10 14 00 - Signage.
  3. Section 11 40 00 - Food Service Equipment.
  4. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.
  5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
  6. Section 27 31 00 – Voice Communications Switching and Routing Equipment.
  7. Prior to beginning work obtain the HVAC Equipment Schedule from Division 23 to determine the related electrical data required to wire each equipment item.
  8. Refer to Coordination Schedule in Division 01 for additional information on Mechanical/Electrical coordination.
  9. See Data, Communications, and Alarm Diagram.
- Wall Switches
  1. For Lighting Circuits and Single Phase Motor Loads Under 1/2 HP:
    - a. NEMA WD1; AC quiet type, nylon, specification grade, UL listed with toggle handle, rated 20 amperes at 120-277 volts AC.
    - b. Mounting straps: metal and offer self-grounding or be equipped with a green hex-head ground screw.
    - c. Handle: Nylon.
  2. Pilot Light Type:
    - a. Lighted handle
  3. Locator Type:
    - a. Lighted handle
    - b. Screw connections only
    - c. Quick push-in wire connectors are prohibited.
  4. District approved Grounding Type or District approved equal:
    - a. Basis of design:
      - (1) Single pole, 20A Leviton 5362
      - (2) Three-way, 20A Hubbell No. 1223-I
      - (3) Single pole, 20A keyed Hubbell No. 1221-L
      - (4) Three-way, 20A, keyed Hubbell No. 1223-L
- Receptacles
  1. Duplex, single and special receptacles:
    - a. UL listed with a metal mounting strap with self-grounding and a hex-head green grounding screw
    - b. 20 amp
    - c. Specification grade
    - d. Nylon
    - e. Flat faced
  2. Convenience and Straight-blade Receptacles:
    - a. NEMA WD 1
    - b. Leviton 5362 (I) Ivory or (W) White,
      - (1) District approved equal
  3. Locking-Blade Receptacles:
    - a. NEMA WD 5.

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4. Convenience Receptacle Configuration:
  - a. NEMA WD 1;
  - b. Type 5-20 R
  - c. Nylon face.
5. All receptacles connected to emergency circuits shall have a red face.
6. Specific-use Receptacle Configuration:
  - a. NEMA WD 1 or WD 5;
  - b. Black plastic face.
7. GFCI Receptacles:
  - a. Duplex convenience receptacle with integral ground fault current interrupter.
8. Isolated Ground Receptacles:
  - a. Duplex receptacle with metal strap for self-grounding and green hex-head source for isolated ground.
  - b. Orange face.
9. Child guard shutter type required at clinic, preschool, kindergarten, and special education areas.
- Floor mounted service fittings
  1. Poke-through Fittings: UL Listed as a fire-rated poke-through device or cast in place
    - a. Coordinate fire stops and smoke barriers in through-floor components.
    - b. Terminate in 4 inch square by 2-1/2 inch deep junction box.
    - c. Device shall have two convenience receptacles and two individual low-tension openings.
- Wall dimmers:
  1. Incandescent Wall Dimmers: NEMA WD 2; linear slide type
  2. Incandescent Wall Dimmer Rating: 600-Watts minimum, larger size to accommodate load
- Wall Plates
  1. Cover Plates: Nylon
  2. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device covers
  3. Metallic Cover
- Cords and Caps
  1. Pendant type outlets:
    - a. Non metallic Daniel Woodhead box and strain relief required
  2. Straight-blade Attachment Plug:
    - a. NEMA WD 1
  3. Locking-blade Attachment Plug:
    - a. NEMA WD 5
  4. Attachment Plug Configuration:
    - a. Match receptacle configuration at outlet provided for equipment.
  5. Cord Construction:
    - a. Oil-resistant thermoset insulated Type SJ, SJO or SO multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.
  6. Cord Size:
    - a. Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

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7. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
8. Make conduit connections to equipment using flexible conduit.
  - a. Use liquidtight flexible conduit in damp or wet locations. (motors, kitchen, technical education shops)
  - b. Cord drops: Use non metallic boxes with strain relief.
9. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
10. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
11. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring.
12. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches. Connect with conduit and wiring.
- Execution Summary
  1. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.
  2. Install wall switches OFF position down.
  3. De-rate ganged dimmers per manufacturer.
  4. Install convenience receptacles with grounding pole on top left where installed horizontally.
    - a. Grounding pole position shall be consistent throughout.
  5. No receptacle shall be located within two horizontal feet of a sink or lavatory.
    - a. Provide GFCI protection within 6 feet of sinks.
  6. Wire receptacles using pigtails for easy future service.
  7. Install cover plates on switches and receptacles in all areas.
    - a. Use jumbo size plates for devices in masonry walls.
  8. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

END SECTION 26 27 26

**26 28 13 Fuses – April 20, 2007**

- Work in this section is restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
  1. Little Fuse Company
  2. Bussman Corporation
- All fuses on the project shall be of the same manufacturer.
  1. Intermixing of fuse type and manufacturers within the same series-connected circuit is prohibited
  2. Fuse types (e.g. KRP-C & FRS) of the same manufacturer within the same series-connected circuit is permitted and encouraged.
- In the absence of other information, the following standards apply:
  1. ANSI C97.1 - Low Voltage Cartridge Fuses 600 Volts or Less
  2. ANSI/UL 198C - High Interrupting Capacity Limiting Class L Fuses

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3. ANSI/UL 198E - Class R Fuses
4. ANSI/UL 198G - Fuses for Supplementary Overcurrent Protection
5. ANSI/UL 512 - Fuseholders
- Submittals
  1. Product Data: Required
  2. Closeout: Submittals listed above, updated to record status.
- Extra Materials:
  1. Fuses: Furnish to Owner 10% or two extra sets of three (whichever is greater) of each fuse type and rating installed on the project. Place inside the spare fuse cabinet.
  2. Fuse Puller: Furnish 2
- Class R Fuses
  1. Dual element time delay 250 and 600 volt AC, 1/10-600 amperes, current limiting, with short circuit rating of 200,000 amperes symmetrical. Comply with U.L. standard 198E.
    - a. Class RK1: LPN-R or LPS-R.
    - b. Class RK5: FRN-R or FRS-R.
- Fuse Blocks: Install fuses in class R fuse blocks.
- Spare fuse cabinet
  1. Mount a spare fuse cabinet in the main electrical room.
  2. NEMA 1 sized as required with hinged cover.
  3. Minimum of 3 full width shelves.
  4. Paint to match switchboard
  5. Label "SPARE FUSE CABINET" in white core black phenolic on the front.
- Install fuses with labels to face towards the front of the switchboard.

END SECTION 26 28 13

**26 32 00 Packaged Generator Assemblies – April 20, 2007**

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
  1. Caterpillar, Inc.
  2. Kohler Power Systems
  3. Onan Company
- In the absence of other information, the following standards apply:
  1. N.E.C. (NFPA 70) including but not limited to, Emergency and Standby Power Generation Systems
  2. NFPA 30 - Flammable and Combustible Liquids Code
  3. NFPA 31 - Standard for the Installation of Oil burning Equipment
  4. NFPA 37 - Standard for the Installation and use of Stationary Combustion Engines and Gas Turbines
  5. NFPA 110 - Standard for Emergency and Standby Power Systems.
  6. Underwriters Laboratories
  7. National Electric Manufacturers Association
  8. National Electric Code

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- Coordination:
  1. Consultant responsible for obtaining approval from State of Colorado for variance which allows use of natural gas generator set. (Preferred)
  2. Concrete housekeeping pad
  3. See Division 22 for piping and connection requirements.
  4. See Data, Communications, and Alarm Diagram.
- Submittals
  1. Submit for approval, in electronic format appropriate to submittal:
    - a. Complete shop drawings,
    - b. Catalog cuts marked to show:
      - (1) Specific manufacturers model numbers,
      - (2) Factory output ratings,
      - (3) Fuel consumption,
      - (4) Ventilation and combustion air requirements,
      - (5) Dimensions,
      - (6) Weight
      - (7) Any special installation instructions for the engine-generator set and all major items of auxiliary equipment including:
        - (a) Generator set including plans and elevations or risers clearly indicating entrance or connection points for all the inter-connections necessary.
        - (b) Automatic transfer switch.
        - (c) Remote annunciator with on-site installation requirements
        - (d) Diagrams including schematics and a single, integrated interconnection wiring diagram for all equipment to be provided. Separate wiring diagrams for various parts of the system which require interconnection will not be accepted.
        - (e) Legends for all devices on all drawings.
        - (f) Color samples for paint finish; beige to match building.
        - (g) Control panel and remote annunciator.
        - (h) Battery and charger.
        - (i) Fuel tank
        - (j) Exhaust system
  2. Closeout
    - a. Submittals listed above,
      - (1) Updated to as-built record status
      - (2) In appropriate electronic format (AutoCAD, PDF, etc.)
    - b. Operation and Maintenance instruction manuals on the complete system and itemized components.
    - c. Detailed operation and maintenance procedures to the Owner's operating personnel or representatives after successful completion of the specified testing. Include code required periodic exercise procedures.
    - d. Keys (6)
    - e. One hour on-site training
- Guarantee specified equipment against defective material and workmanship under the terms of the manufacturer's and dealer's standard published warranty.
  1. Minimum period of one year from the date of the initial startup and acceptance of the system.

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2. Include labor and travel time and mileage for necessary repairs at the jobsite.
- Supplier must have not less than 80% of the serviceable parts items for the generator set in his local inventory.
- Generator Set
  1. Products submitted must be manufactured as a complete unit, and be supplied by that manufacturer's franchised, authorized dealer only.
  2. Under no circumstances will assemblers of engine generator sets be acceptable.
  3. Authorized dealers must have complete, local replacement parts stock, and shop and field service capability for all equipment to be supplied, with a facility within 90 miles of the job location.
  4. Factory built complete unit shipped to the job site and unloaded by an authorized dealer/distributor.
  5. U.L. 2200 listed.
- Engine
  1. Natural gas preferred
  2. Water cooled, four stroke cycle compression ignition, i.e. diesel type, meeting specified generator output when operating on Number 2 domestic burner oil at the site altitude.
  3. Two-stroke cycle engines will not be considered
  4. Engines requiring premium fuels will not be considered.
  5. Maximum operating speed: 1800 RPM.
  6. Fuel, full flow lubricating oil, and dry type air filters, lube oil cooler, fuel transfer pump, fuel filter, fuel priming pump, and unit mounted instruments including a fuel pressure gauge, water temperature gauge, and lubricating oil pressure gauge.
  7. Engine governor: Standard mechanical type to maintain frequency regulation of not more than 2% from no load to full rated load with recovery within 2 seconds and 0.5% steady state.
  8. Provide a Vernier type speed adjust.
  9. Safety shut offs for high water temperature, low oil pressure, over speed and engine overcrank.
  10. Guards over all exposed moving parts as required by OSHA.
  11. Mount the unit on a structural sub-base with suitable vibration isolators for noise and vibration attenuation.
    - a. Securely fasten to housekeeping pad
- Generator:
  1. Manufacturer rated for continuous standby service with size rating per engineer and derated for the elevation and wide temperature range.
  2. 6 pole reconnectable brushless synchronous generator with brushless excitor.
  3. Three-phase single bearing synchronous type, directly connected to the engine through a flexible disc drive.
    - a. Gear reductions of any kind will not be allowed.
  4. Built to NEMA standards, except that maximum temperature rise at its specified output shall be limited to 130 (standby) degrees C. rise by resistance over a 40 degrees C. ambient.
  5. Minimum Class F insulation: Materials shall not support fungus growth.
  6. Incorporate reactive droop compensation and include a resettable thermal protector for exciter/regulator protection against extended low power factor operation.

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7. Rotor: Include amortisseur windings.
  8. Generator mounted volts per hertz type exciter/regulator provided to match the characteristics of the generator the turbo-charged engine.
  9. Voltage regulation: Plus or minus 1% from no load to full rated load.
  10. Readily accessible voltage drop, voltage level and voltage gain controls.
  11. Voltage level adjustment: Minimum of plus or minus 5%.
  12. Solid state regulator module: Shock mounted and epoxy encapsulated for protection against vibration and atmospheric deterioration.
- Cooling System:
    1. Engine mounted radiator with a blower-type (pusher) fan to maintain safe engine temperature at operating ambient temperature of 120 degrees F. at the installed elevation.
    2. Equip radiator with a duct adapter flange and a lockable cap.
    3. Air restriction for the radiator system shall not exceed .5 inches water.
    4. The cooling system solution: 50% Ethylene Glycol and de-ionized water.
  - Fuel System:
    1. Natural gas or double wall fuel storage tank with capacity for 24 hours of operation at full load built into structural steel sub-base of the unit.
    2. Designed and constructed to withstand the vibration of continuous operation of the engine.
    3. Equip tank with a raised, sealed and lockable filler cap, mechanical visual level gauge, low level switch for status panel, interstitial leak monitor for status panel and a vent line extended above normal snow level.
    4. Provide flexible fuel connections at the engine.
  - Exhaust System:
    1. Properly sized, critical silencing level muffler and piping including a seamless, bellows type flexible connector.
    2. Horizontally mounted muffler supported independently of the engine, so that none of its weight is supported by the engine turbocharger.
    3. Threaded or flanged fittings with the proper gaskets.
      - a. Clamp-type fittings are prohibited.
    4. If the outlet of the muffler is at less than 6 feet from the finished grade at the installed location: Turn pipe up to 90 degrees and terminate with a flapper type rain cap.
    5. If the outlet is above 6 feet from the ground, cut the horizontal pipe off at a 45 degree angle to the horizontal and weld a one inch mesh bird screen over the end.
  - Starting motor:
    1. DC electric starting system with positive engagement motor.
    2. Motor voltage as recommended by the engine manufacturer.
  - Automatic Control:
    1. Fully automatic generator set start-stop controls in the generator control panel.
    2. Provide shut-down for low oil pressure, high water temperature, overspeed, overcrank and 3PDT auxiliary relay for activating accessory items.
    3. Include a 30 second single cranking cycle limit with lockout.
  - Jacket Water Heater:
    1. Unit mounted thermal circulation type water heater incorporating a thermostatic switch to maintain engine jacket water to 80 degrees F.
    2. 120 volts, single phase, 60 Hertz.

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3. Vee type engines require one heater per each bank of cylinders.
- Batteries:
  1. Lead-acid storage battery set for maintenance free, heavy duty diesel starting.
  2. Battery voltage compatible with the starting system.
  3. Battery set rated not less than 700 cold cranking amps at 0 degrees F.
- Battery Racks:
  1. Metal treated to be resistant to deterioration by battery electrolyte.
  2. Construct so that non-conductive insulation material directly supports the cells.
- Battery Charger:
  1. Dual rated, DC regulated, line compensated battery charger to automatically recharge the batteries.
  2. Float at 2.17 volts per cell and equalize at 2.33 volts per cell.
  3. Include overload protection, silicone diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input.
  4. AC input voltage: 120 volts, single phase.
  5. Amperage output: 10 amperes minimum.
  6. Wall mounting type in NEMA 1 enclosure, by the generator supplier, mounted in the housing and connected to the battery on the DC side.
- Main Line Circuit Breakers:
  1. Main-line, molded case circuit breaker mounted upon and sized to the output of the generator installed as a load circuit interruption and protection device.
  2. Operate both manually for normal protection device.
  3. Operate both manually for normal switching functions and automatically during overload and short circuit conditions.
  4. Equipped with bus bars on the line side for bolted connection of the generator leads, and output lugs for on the line side of the circuit breaker.
  5. Size at 115% of generator full load current.
  6. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection.
  7. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.
- Generator Control Panel:
  1. A generator mounted NEMA 1 type, vibration isolated 14 gauge steel control panel containing, but not be limited to the following equipment:
    - a. Frequency meter, 3 1/2 inch, dial type, 45-65 Hz.
    - b. Voltmeter, 3 1/2 inch, 2% accuracy.
    - c. Ammeter, 3 1/2 inch, 2% accuracy.
    - d. Ammeter (4 position)-Voltmeter (7 position) phase selector switch.
    - e. Automatic starting control as specified.
    - f. Voltage level adjustment rheostat.
    - g. Dry contacts for remote alarms wired to terminal strips.
    - h. Individual fault indicator lights for low oil pressure, high water temperature, overspeed and overcrank and a push to test indicator light.
    - i. A pressure gauge.
    - j. A 3 PDT aux relay connected to a terminal strip.
    - k. A 4 position function switch marked "auto", "manual", "off-reset" and "stop".
    - l. Running time meter, oil pressure and water temperature gauges.

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- m. Hinged, solid protective cover with provision for locking.
- Annunciator Panel:
  1. Panel for remote mounting to give audible and visual warning of all the above listed alarm conditions in the generator system. The panel shall conform with the requirements for the National Electrical Code, Section 700, and the National Fire Protection Association, Section 110 - Level 2.
  2. The panel shall be remote mounted in a designated location as shown on the drawings and shall include all alarms required by this guideline.
- Enclosure:
  1. Enclose the complete unit with all accessories in an insulated, sound attenuated, weatherproof enclosure suitable for outdoor use.
  2. Provide necessary heavy gauge metal screens to prevent small rodent access.
  3. Provide access doors with full length piano type hinges to allow access to all components for normal maintenance and inspection.
  4. Doors: Locking handles with matching keys.
  5. Rainproof louvers sized for the generator manufacturers recommended air flow through the housing.
  6. Mount the silencing muffler on top of the enclosure as specified with a rain collar roof penetration.
- Automatic Load Transfer Switch(es) (ATS):
  1. Provide number of ATS units required by NEC and State code.
    - a. Life safety systems
    - b. Owner provided power system, as directed by Owner
  2. Number of poles and current ratings as required for a normal and emergency source voltage.
  3. Listed per U.L. Standard 1008 as recognized components for emergency systems, and rated for 125% of total system load.
  4. Automatic pickup voltage adjustable from 85% to 100% of nominal (set at 90%)
  5. Dropout voltage adjustable from 75% to 98% of the pickup value (set at 85%).
  6. Electrically operated, mechanically held, and be suitable for continuous duty in an unventilated enclosure at 100% rated load.
  7. Inherently double throw so both sets of contacts move simultaneously when the switch is transferring.
  8. Mechanically interlocked to ensure that only one side can be closed at a time.
  9. Main contacts: Silver alloy wiping action type; Protected by arcing contacts in sizes above 400 amperes.
  10. Switch and relay contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch panels from the enclosure and without disconnection of drive linkages or power conductors.
  11. Sensing and control relays: Continuous duty industrial control type with minimum contact rating of 10 amperes.
  12. Automatic Transfer Switches utilizing components of molded case circuit breakers, circuit interrupters, disconnect switches, or parts thereof which were not intended for repetitive switching are not acceptable.
  13. An overload or short-circuit shall not cause the transfer switch to go into a neutral position.
  14. Harnessing between the transfer switch and the control panel shall have built in

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disconnect feature for routine maintenance.

15. Supply in a NEMA 1 enclosure for wall mounting.

16. ASCO, Russelectric RMT series or Zenith ZTS series, or as manufactured by the generator set manufacturer.

- Accessories:

1. A time delay to override momentary normal source outages to delay all transfer switch and engine starting signals. Field adjustable from 0.5 to 6 seconds and factory set at 3 seconds.

2. A time delay on retransfer to normal source. Automatically bypassed if the emergency source fails and normal source is available. Field adjustable from 0 to 10 minutes and be factory set at 10 minutes.

3. An unloaded running time delay for emergency generator cool-down. Field adjustable from 0 to 5 minutes and factory set at 5 minutes.

4. Automatic exercise timer with programmable logic and with or without load pickup selection.

5. Independent single phase voltage and frequency sensing of the emergency source. Adjustable from 85% to 100% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.

6. A contact that closes when normal source fails for initiating engine starting, rated 10 amperes. Gold plated for low voltage service.

7. Pilot lights to show switch position.

8. One set or normally open and one set of normally closed auxiliary contacts on each side of the switch.

9. A test switch to momentarily simulate normal source failure.

- Installation by manufacturer/supplier

1. Unload the equipment and insure that it is properly set in place with all vibration isolators properly installed.

2. Provide technical assistance to the electrical contractor as required for interconnection of the system.

- Testing

1. Provide results of 100% load bank test at the factory prior to shipping.

2. Upon completion of the installation, test the generator system to confirm it is free of any defects, the phase rotation matches the incoming utility, it will start automatically within code required time and will automatically transfer and retransfer the loads.

3. The system shall be subjected to full rated load test through the use of dry type load banks designed for this purpose.

4. The load bank shall be capable of definite and precise incremental loading, and the load settings shall not be dependant upon the generator control instrumentation to read amperage and voltage of each phase. Rather, the test instrumentation will serve as a check of the generator set meters.

5. Load bank testing shall be required at the factory and the results are to be received on site before installation may begin.

6. All load tests (at the factory and on site) to be a minimum of 2 hours and recorded on a log showing load, ambient temperature, oil pressure, etc. on 10 minute intervals.

7. After testing and startup is completed, completely fill the fuel tank and add oil to the engine as necessary.

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- Connections:
  1. Due to vibration, install stranded wire from generator to:
    - a. Remote annunciator
    - b. Block Heater
    - c. Battery Charger
  2. Provide independent branch circuitry (IBC) for battery charger.
  3. Provide IBC for charger, both served from life safety panel.
- Start-up and Instruction
  1. On completion of the installation, start-up the generator set by manufacturer's factory trained service representative as a part of and immediately prior to the specified testing.
- Monitor ATS units with Johnson Controls Metasys or fire detection panel.

END SECTION 26 32 00

**26 35 00 Power Filters and Conditioners – April 20, 2007**

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
  1. Current Technologies
  2. Liebert
- Coordination
  1. Section 26 05 26 – Grounding and Bonding for Electrical Systems
  2. Section 26 05 53 - Identification for Electrical Systems
  3. Section 26 24 00 – Switchboards and Panelboards
- References
  1. In the absence of other information, the following standards apply:
  2. ANSI/IEEE compliance; Comply with ANSI/IEEE C62.1, C62.41 and C62.45.
  3. NEC as applicable to construction and Article 280 for installation.
- Submittals
  1. Product Data: Required
  2. Shop Drawing: Required
  3. Design Data, Test Reports, Certificates, Manufacturer Instructions, Manufacturer Field Reports:
    - a. TVSS specifications, and the latest addition of the UL 1449 surge suppression rating Category C3 for the Filter.
  4. Closeout:
    - a. Submittals listed above, updated to record status.
    - b. Maintenance manuals
- Warranty
  1. TVSS shall be warranted for 5 years
  2. Label equipment on inside of door with length of warranty from date of acceptance.
- Maintenance Service
  1. Local service support shall be provided for TVSS such that upon failure, a replacement shall be available within twenty-four hours.

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- TVSS
  1. Mechanical and electrical requirements suitable for application in category C3 environments as described in ANSI/IEEE C62.41.
  2. TVSS must not affect the performance of the frequency corrected slave clock system.
- Manufacturer Qualifications:
  1. Regularly engaged in the manufacture of TVSS product for category C3 (ANSI/IEEE C62.41) and whose products have been in satisfactory service for not less than ten years.
- TVSS Installation:
  1. The conductors are to be as straight and short as practically possible; not to exceed 10 feet in length.
- Install an appropriately sized manual safety/disconnect switch or circuit breaker before and in line with TVSS. Capable of electrically isolating the TVSS from the electrical service for repair without interrupting service to the building.
- TVSS units must be downstream of main distribution center (MDC) disconnect.

END SECTION 26 35 00

**26 51 00 Interior Lighting – February 26, 2008**

- Comply with State adopted Energy Management Codes.
- Consultant to coordinate documentation requirements for Xcel rebates.
- Interior Illumination Levels (dimensions indicate distance above finished floor)
  1. Classrooms: 50 FC maintained at desktop level
  2. Offices, cafeterias, workrooms, libraries, clinics and labs: 50 FC maintained at 36 inches
  3. Art, drafting, auto and wood shops, tech arts: 60 to 70 FC maintained at 36 inches
  4. Computer rooms: 50 FC maintained at 36 inches
  5. Corridors, hallways, storage rooms, mechanical rooms: 30 FC maintained at 36 inches
  6. Kitchens: 50 FC maintained at 30 inches
  7. Gymnasium (maintained at 30 inches above floor ): T-8, T-8 HO, Super T-8, T-5 HO
    - a. Three (3) levels of light via two (2) switches
    - b. Elementary Schools: 50 FC
    - c. Middle Schools: 60 FC
    - d. High Schools: 70 FC
  8. Other rooms: 30 FC maintained at 36 inches
- In the absence of other information, standards of the following organizations apply:
  1. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts.
- Submittals
  1. Product Data: Required
    - a. Include outline drawings, lamp and ballast data, replacement lamp costs, photometric study, support points, weights and accessory information for each luminaire type.
  2. Manufacturer Instructions: Required
  3. Closeout: Submittals listed above, updated to record status
- Extra Materials:

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1. Lamps: 10% lamps of each type
  2. Lenses: 3% of quantity of lenses furnished, minimum of one of each size and type
  3. Ballasts: 10% ballasts of each type
  4. Project Manager responsible for count.
- Luminaires:
    1. Open to any product or material meeting the requirements of this Technical Guideline.
    2. Fluorescent (recessed) Luminaires:
      - a. Hinged frames with latches and K-19, DB-12 or equal lenses.
      - b. Trim type and accessories required for installation in ceiling system installed
      - c. Maximum depth = 6 inches, including yokes and bridges.
    3. HID Luminaires:
      - a. Pre-wired with integral ballast.
      - b. Consider remote ballast designs to mitigate noise in assembly areas.
      - c. Self-extinguishing lamps
    4. Incandescent lamps and fixtures are not permitted.
    5. Types
      - a. Locker Rooms: Vandal-resistant
      - b. Kitchens: Vapor-resistant; gasketed
      - c. Gymnasium: Protective wire guard cover required, in addition to clear fixture lens
    6. Each luminaire to have its own ballast
      - a. Tandem wiring is not approved.
    7. Locate luminaires for easy service; i.e. stairways, theaters, common areas.
    8. LED technology should be considered, such as auditoriums and theaters.
  - Egress Lights ("frogeyes") only used in locations where no emergency generator set exists, or as required by code for specific rooms
    1. Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1, or District approved equal
      - a. Dualite LZ series, self testing
        - (1) Basis of design
    2. As required by IBC and at occupied windowless rooms.
    3. Self-diagnostic
  - Exit Signs
    1. Restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
      - a. Exitronics 500 Series
      - b. Isolite, LPDC Series
    2. Light emitting diode (LED) type
    3. Directional arrows
    4. Surface mount type
  - Lamps
    1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
      - a. General Electric
      - b. Osram
      - c. Sylvania

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- d. Venture
2. Single manufacturer throughout facility or project
3. Provide an appropriate lamp for each luminaire provided.
4. It is the intent of the School District to limit the number of different types of lamps that must be stocked for replacements.
5. Specify the longest-rated life lamps available.
6. Adjust lamp wattages to optimize lamp life ratings.
7. Fluorescent Lamps:
  - a. 4100°K, F32T8,
  - b. CRI= 80;
  - c. T-8, T-8 HO, Super T-8, T-5 HO
  - d. 3-step 25/60/80
  - e. Light level in high school gym 30-70-100%
8. Metal Halide HID Lamps:
  - a. Phosphor coated
  - b. Self extinguishing type
  - c. Avoid HID lighting interior.
9. High Pressure Sodium HID Lamps:
  - a. Suitable for all burning positions.
  - b. Permitted only when matching existing
  - c. 400 Watt and above
10. Mercury Vapor HID Lamps: Prohibited
- Ballasts
  1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department:
    - a. Advanced
    - b. General Electric
    - c. Jefferson
    - d. Magnetek
    - e. Motorola
    - f. Universal
    - g. Sylvania
  2. Fluorescent ballast:
    - a. High efficiency electronic
    - b. Programmed start
    - c. Parallel circuited
    - d. Power factor greater than .9 and THD less than 10%.
  3. HID:
    - a. Per ANSI C82.4
  4. Provide minimum 40 k cycle ballast
- Installation
  1. Locate luminaires for reasonable maintenance access.
  2. Avoid positioning fixtures where special lifts and scaffolding would be required to service the fixture.
  3. Support Surface-mounted luminaires directly from building structure.
    - a. Use hangers rated for the fixture
    - b. Provide safety chain or cable between the ballast/structure and/or

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fixture/structure.

- c. Brace pendants four feet or longer to limit swinging
4. Attach with bolts, screws, rivets or approved ceiling framing member clips.
  - a. Plastic and lead anchors are prohibited.
5. Install recessed luminaires to permit removal from below.
6. Upon completion of work, replace failed lamps
7. Align luminaires and clean lenses and diffusers of paint splatters, dirt and debris.
8. See Data, Communications, and Alarm Diagram.

END SECTION 26 51 00

**26 55 61 Theatrical Lighting – April 20, 2007**

- Work in this section is restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
  1. Dimming and Control Systems:
    - a. Electronic Theatre Controls
    - b. Leviton Colortran
    - c. Strand Lighting
  2. Fixtures:
    - a. Altman: PARS and Cyc lights only
    - b. Electronic Theatre Controls
    - c. Lycian
    - d. Phoebus
    - e. Strand Lighting
  3. Suppliers not included in the approved manufacturers list must submit the following information ten days prior to the bid date to be considered as an alternate supplier for the specified system.
    - a. Three sets of annotated manufacturer cut sheets
    - b. Complete one-line drawing of the proposed system
    - c. List of three projects of similar size and scope located in the local area.
- Section includes requirements for elementary, middle and high school theatrical lighting systems.
- Section Includes
  1. Flexible and controllable stage lighting to provide adequate illumination for performances such as plays, musicals, orchestra, choir and assemblies.
  2. Lighting for front stage, overhead, back stage and “house”.
- Submittals
  1. Product Data: Required
    - a. Five sets of annotated manufacturers cut sheets for approval by engineer / architect prior to installation
  2. Shop Drawings:
    - a. Required
    - b. Five sets for approval by engineer / architect prior to installation

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- c. Include:
  - (1) Complete drawings of all racks, enclosures, control stations and wiring devices for the system, including:
    - (a) Power feeds
    - (b) Load and low voltage terminations
    - (c) Wire types
    - (d) Physical space requirements
    - (e) Station locations
    - (f) Power requirements
    - (g) All other installation information
  - (2) Complete system one line diagram
    - (a) Power requirements
    - (b) Emergency generator connections
    - (c) Line voltage connections to the dimmer rack(s)
    - (d) Processor connections detail
    - (e) Wire entry points
    - (f) Control station details
    - (g) Control relays
    - (h) Emergency power transfer devices
  - (3) Complete bill of materials, including:
    - (a) Manufacturers part numbers
    - (b) Manufacturers component drawings
    - (c) Point to point details
- 3. Closeout:
  - a. Three sets of submittals listed above, updated to record status.
    - (1) One electronic copy of:
      - (a) Complete systems drawings in AutoCAD
      - (b) Manufacturer's annotated cut sheets
      - (c) System maintenance manuals
      - (d) Warranty
      - (e) Factory contact information
      - (f) Local service center information
    - (2) Written documentation of performance testing
  - b. Owners' manuals for all system equipment and distribution components
  - c. Operation and Maintenance Data
    - (1) Three copies of all software required to communicate with and program the system
  - d. Demonstration and Training
    - (1) Training of Owner's maintenance personnel and teaching staff shall be provided by a factory authorized service representative
    - (2) Training to include information on adjusting, operating and maintenance of stage lighting equipment
    - (3) Provide two sessions:
      - (a) One at project completion
      - (b) One approximately 45 days after students occupy the building
        - 1. Session to be minimum of 4 continuous hours

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- Quality Assurance
  1. Installer qualifications:
    - a. Licensed electrical contractor in the State of Colorado
      - (1) Working in conjunction with a theatrical specialist engaged in the sale, design, operation and installation of theatrical dimming systems.
  2. Theatrical Specialist qualifications:
    - a. Presently engaged in the sale, design, installation and operation of theatrical dimming systems.
  3. Dimming Equipment Manufacturer qualifications:
    - a. Minimum ten years of continuous and exclusive experience in the manufacture of theatrical systems
    - b. Maintains a service center which provides:
      - (1) Training
      - (2) Parts
      - (3) Emergency repair support within 24 hours maximum response time
  4. Electrical Components, Devices, and Accessories:
    - a. Listed and labeled in accordance with NFPA 70, Article 100
    - b. Listing and label provided by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  5. Emergency Transfer:
    - a. Comply with UL 1008
  6. Microprocessor-based modular system
    - a. Consisting of dimmer and control modules operated from remote-control stations and a control module
    - b. Comply with UL 508
    - c. Comply with USITT DMX 512 and USITT CAN for data transmission
  7. See Division 01, General Requirements, for warranty information.
- Elementary School Performance
  1. Dimmer system:
    - a. 24 Circuits of 1.2 kW or 2.4 kW dimmers
    - b. DMX controlled
    - c. Convection cooled
    - d. Fused, fan cooled, triac or plastic dimmers are not acceptable.
    - e. UL listed 3 phase distributed, convection cooled dimmer is acceptable.
    - f. Fan cooled dimmers may be used, if located in a separate acoustically isolated space.
  2. Portable 24 channel DMX console
    - a. With minimum 24 submasters
  3. Two sets of 6 – 500 watt PAR 64 fixtures
    - a. With gel frames
    - b. Mounted in basketball resistant steel cage
    - c. Mount 45 degrees up from, and parallel to, the front edge of the stage
    - d. Attached to building structure with load rated hardware
    - e. All lamps will be provided in the longest life model available for the fixture
  4. One row of 6 – PAR 38 fixtures
    - a. With gel frames
    - b. Locate on the upstage side of the proscenium wall

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- c. Mount on pre-wired theatrical plug strips attached to building structure with load-rated hardware.
  - 5. One DMX receptacle
    - a. Locate on the side wall of the stage area at +24" AFF.
  - 6. One eight button DMX snap-shot station
    - a. Locate at:
      - (1) +4' AFF
      - (2) Directly above DMX receptacle
      - (3) In a recessed metal locking enclosure
  - 7. Provide one each, 10' and 100' DMX control cables
  - 8. Gymnasium house lighting
    - a. Incandescent down lights for seating area
      - (1) Provide 3-5 footcandles of illumination
      - (2) Control by the dimming system
    - b. Fluorescent or HID gym lights will not be connected to system
- Middle School Performance (Cafetorium)
  - 1. Dimmer system:
    - a. 36 Circuits of 2.4 kW dimmers
    - b. DMX controlled
    - c. Convection cooled
    - d. Fused, triac or plastic dimmers are not acceptable.
    - e. UL listed 3 phase distributed, convection cooled dimmer is acceptable.
    - f. Fan cooled dimmers may be used, if located in a separate acoustically isolated space.
  - 2. Portable 36 channel DMX console
    - a. With minimum 24 submasters
  - 3. Two sets of 6 – 575 watt ellipsoidal fixtures
    - a. With gel frames
    - b. Mounted on a pre-wired theatrical plug strip
      - (1) Mount 45 degrees up from, and parallel to, the outside edges of the stage area
    - c. Fixtures to be located directly over a flat, level surface easily accessible by ladder or non-articulating lift.
  - 4. One row of 16 – PAR 38 fixtures
    - a. With gel frames
    - b. Locate approximately 4' upstage of the proscenium wall
    - c. Mount on pre-wired theatrical plug strips
  - 5. One row of 16 – PAR 38 fixtures
    - a. With gel frames
    - b. Locate mid-stage
    - c. Mount on pre-wired theatrical plug strip
  - 6. All plug strips shall be hung with load rated hardware (proof coil chain, turnbuckles, eyebolts, etc.)
    - a. Capable of 500 pound per support point
      - (1) Attached to building structure
    - b. All hanging plug strips shall be supported every 5 – 8 feet.
  - 7. One DMX receptacle
    - a. Locate on the side wall of the stage area at +24" AFF.

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8. One eight button DMX snap-shot station
    - a. Locate at:
      - (1) +4' AFF
      - (2) Directly above DMX receptacle
      - (3) In a recessed metal locking enclosure
  9. Provide one each, 10' and 100' DMX control cables
  10. Cafetorium/Gymnasium house lighting
    - a. Incandescent down lights for cafeteria seating area
      - (1) Provide 3-5 footcandles of illumination
      - (2) Control by the dimming system
        - (a) Also operated by initiation of the fire alarm system
      - (3) Connect to emergency generator circuit(s) through power relays
  11. Fluorescent cafeteria lights will not be connected to system
  12. All dimming receptacles and fixture plugs shall be 20 amp, grounded stage pin.
- High School - Auditorium
    1. Dimmer system:
      - a. Minimum 108 Circuits controlled by 2.4 kW dimmer modules
        - (1) Two modules shall be constant (non-dimmable)
        - (2) System to support DMX and ASCN control consoles
        - (3) Mechanical engineer shall provide heat dissipation design, based upon the operating requirements of the system provided by electrical engineer.
        - (4) Rack shall be located in a room acoustically isolated from the stage, audience and control booth.
    2. Minimum 125 channel DMX console/LCD monitors
      - a. With minimum 24 submasters
      - b. 2 DMX ports
      - c. ACN port
      - d. 100 cue capacity
      - e. Located in a lighting booth at the rear of the theater
    3. Theatrical plug strips
      - a. Mounted to an accessible catwalk which runs the full width of the stage
        - (1) Capable of supporting 18 – 575 watt ellipsoidal fixtures with gel frames
      - b. Mount plug strips to stage side of catwalk
        - (1) No closer than 45 degrees nor farther than 30 degrees up from the front of the stage
      - c. Provide one ACN and one DMX control receptacle
    4. One row of 20 – 575 watt ellipsoidal fixtures / PAR fixtures / Fresnels
      - a. With gel frames
      - b. Mounted on a pre-wired theatrical plug strip
        - (1) Locate approximately 2 feet upstage of the proscenium wall
      - c. Minimum of 15" from the main curtain
    5. One row of 16 – 575 watt PAR fixtures
      - a. With gel frames
      - b. Locate mid stage
    6. One row of 6 – 1000 watt 3 cell cyc light units
      - a. With gel frames
      - b. Locate 4' in front of upstage backdrop

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7. On-stage fixtures shall be powered from theatrical plug strips
  - a. 6' longer than the proscenium opening
  - b. Masked by flame-resistant stage drapery so fixtures are not visible from the third row of audience seating
  - c. Side walls of the stage area should not be visible from the third row center audience seats.
  - d. Plan and section views of the theater are required to verify sight lines
8. All pre-wired plug strips shall be hung with load rated hardware (proof coil chain, turnbuckles, eyebolts, etc.)
  - a. Capable of 500 pound per support point
    - (1) Attached to building structure
  - b. All hanging plug strips shall be supported every 5 – 8 feet.
9. Four sets of 4 dimmable receptacles
  - a. Locate +24" AFF
  - b. Mount on stage walls
  - c. 2 sets per side
10. One DMX input and output receptacle and 1 ACN receptacle
  - a. Locate on the walls of the stage at +24" AFF.
  - b. Dual DMX receptacles and ACN receptacle shall be located in the control booth.
11. One eight button DMX snap-shot station
  - a. Locate at:
    - (1) +4' AFF
    - (2) Directly above control receptacles
    - (3) On same side of stage as any sound controls
12. Dimmable incandescent down lights for auditorium seating area
  - a. Provide 3-5 footcandles of illumination
  - b. Fixtures to be accessible from the catwalk or a non-articulating lift on a flat, level surface
  - c. Sconces shall be used to fill in perimeter seating light and paths of egress
13. Integrate a second layer of non-dimmable, extended life fluorescent, auditorium house lighting and stage lighting into the system
  - a. These lights will provide an average of 30 – 35 footcandles for classroom and rehearsal purposes
    - (1) Shall conform to I.E.C.C. requirements
    - (2) Fixtures to be accessible from the catwalk or a non-articulating lift on a flat, level surface
    - (3) It is understood that a degree of uniformity of light will be sacrificed as part of this requirement.
  - b. Wall-mounted stage perimeter lights will illuminate paths of egress.
  - c. LED fixtures shall be used to illuminate audience egress steps and the edge of the stage.
  - d. Control these circuits with non-dim modules.
  - e. House and stage fixtures will illuminate in the event of:
    - (1) Utility power outage
    - (2) Loss of power to the dimmer rack
    - (3) Activation of the fire alarm system.
14. Locate entry stations to activate the stage and auditorium non-dim lighting

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- a. In metal locking enclosures at every entry to the auditorium area
- b. Sconces and LED fixtures will be included with the entry station preset.
15. Locate preset stations at every entry to the stage for:
  - a. Activation of:
    - (1) Auditorium non-dim lights
    - (2) Stage non-dim lights
    - (3) Stage perimeter lighting
    - (4) Performance sconce lighting
16. Provide OSHA approved fixture access with the system
17. Individually circuited duplex receptacles shall be provided in the control booth for:
  - a. Lighting console
  - b. Front catwalk
  - c. Two for followspots
  - d. Four on stage side walls for tools and lifts
  - e. Four for the orchestra area
18. Provide a locally dimmed track light system above the lighting control console in the booth.
19. Provide a communication system for:
  - a. Followspots
  - b. Stage control position
  - c. Orchestra area
  - d. Lighting console
  - e. Dressing Rooms
20. Provide the following deliverables to Project Manager:
  - a. 50 sheets theatrical gel
  - b. 5 gel storage drawers
  - c. Complete lens sets for each 575 watt PAR
  - d. 10% spare lamps
  - e. 15 Grounded pin extension cords
  - f. 2-15 duplex receptacle x 50' orchestra stinger
  - g. 2 ellipsoidal iris
  - h. 10 pattern holders
  - i. 10 patterns to include
    - (1) 5 breakups
    - (2) 5 realistic stars
  - j. 2-25' DMX cables
  - k. 2 manually operated theatrical followspots
    - (1) With stands capable of a minimum 100 footcandles at 2' circle from the booth location
    - (2) Drawing no more than 10 amps at 120 VAC.
21. All dimming receptacles and fixtures plugs shall be 20 amp grounded stage pin.
- Identification
  1. Permanently identify components, control stations, power and control wiring
    - a. Reference 26 05 03, Identification for additional information
    - b. Label each lighting outlet, distribution device, and dimmer module with unique designation.
      - (1) Plug strips shall be labeled with 2" vinyl labels

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- (2) Outlet boxes shall be labeled with 1” vinyl labels
- c. Circuits shall be ordered sequentially from Down Stage Left to Up Stage Right
  - (1) Architectural lights shall be at the end of the dimmer rack
- d. DMX communication and network between booth, stage, front light position and dimmer rack will be permanently labeled and identified in High School systems.
- Field Quality Control
  - 1. Manufacturers’ Field Service:
    - a. Engage a factory-authorized service representative to inspect, test and adjust field assembled components and equipment installation, including connections and to assist in field-testing.
  - (1) Operational Tests:
    - (a) Connect each outlet to a fixture and a dimmer output circuit, to test each dimmer module, dimmer control, output circuit and output receptacle.
    - (b) Include operation, testing and control of:
      - 1. Houselights and stage lights
      - 2. Network outlets from each control location and station
        - a. Include optional plug-in control console locations
  - b. Provide written documentation of performance testing.

END SECTION 26 55 61

**26 56 00 Exterior Lighting – April 20, 2007**

- In the absence of other information, standards of the following organizations apply:
  - 1. ANSI C82.4 - Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type.)
- Submittals
  - 1. Product Data: Required.
    - a. Include outline drawings, lamp and ballast data, replacement lamp costs, photometric study, support points, weights and accessory information for each luminaire type
  - 2. Manufacturer Instructions: Required
  - 3. Closeout:
    - a. Submittals listed above
    - b. Updated to record status.
    - c. Provide in electronic format, appropriate to submittal type (AutoCAD, PDF, etc.)
  - 4. Extra Materials:
    - a. Lamps: 10% lamps of each type.
    - b. Lenses: 3% of quantity of lenses furnished, minimum of one of each size and type.
    - c. Ballasts: 10% ballasts of each type.
  - 5. Warranty:
    - a. 1 year, ballast and labor.
  - 6. Provide Carlon curved junction boxes in all exposed pole foundations.
    - a. Provide dividers where required, i.e. power/cameras.
  - 7. Make splices in Carlon boxes, not poles.
  - 8. See Data, Communications, and Alarm Diagram.
- Exterior Luminaires

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1. Open to any product or material meeting the requirements of this Technical Guideline.
  2. Designed to minimize light trespass, sky pollution, and glare.
  3. Enclosures: Complete with gaskets to form weatherproof assembly.
  4. Wind Load: 125 mph velocity with luminaires and brackets mounted.
- Lamps
    1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
      - a. General Electric
      - b. Osram
      - c. Sylvania
      - d. Venture
    2. Single manufacturer throughout
    3. It is the intent of the School District to limit the number of different types of lamps that must be stocked for replacements.
    4. Provide an appropriate lamp for each luminaire provided.
    5. Specify the longest-rated life lamps available.
    6. Adjust lamp wattages to optimize lamp life ratings.
    7. Provide an appropriate lamp for each luminaire provided.
    8. Metal Halide HID Lamps:
      - a. Phosphor coated.
      - b. Self extinguishing type.
    9. High Pressure Sodium HID Lamps:
      - a. Suitable for all burning positions.
      - b. Permitted only when matching existing
      - c. 400 Watt and above
    10. Mercury Vapor HID Lamps: Prohibited
    11. Halogen Lamps
      - a. By approved lamp manufacturers
  - Lighting Control
    1. Restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
    2. Johnson Controls Metasys bypass control.
      - a. Locate in the front office adjacent to the main fire panel
      - b. Electronic 10-20-60 minutes time delay off
      - c. All lighting contactors shall have HOA control on or beside each contactor.
    3. Paragon Electric Company EL 71/72 Suntracker Series Digital Control Clock.
  - Provide adequate light levels to provide egress.
    1. Coordinate light levels with security camera requirements.
  - Ballasts
    1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1 Facilities Services Department.
      - a. Advanced
      - b. General Electric
      - c. Jefferson

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- d. Magnetek
  - e. Motorola
  - f. Universal
2. Low temperature rated with reliable starting to -20 degrees F
- Poles:
    1. Open to any product or material meeting the requirements of this Technical Guideline.
    2. Square, metallic non-tapered profile is preferred.
    3. Include manufacturer's standard hand access hole with matching gasketed cover plate
    4. Provide template, flat washer, lock washer and hex nuts for each pole.
    5. UFER grounds are required for metallic poles.
    6. Project anchor bolts 4 inches minimum above base. Trim as required.
    7. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles
    8. Provide double nuts for adjustment
    9. Finish concrete foundation to a fine stone finish
      - a. Chamfer top edge
    10. Base coverplate trim
  - Pole connection
    1. Make splices in Carlon curved J box in base, not in pole.
    2. Use divider when providing camera wiring
  - Installation
    1. Locate luminaires with reasonable maintenance criteria in mind.
    2. Support Surface-mounted luminaires directly from building structure.
    3. Attach with bolts, screws, or District approved ceiling framing member clips.
      - a. Plastic anchors are prohibited.
    4. Install recessed luminaires to permit removal from below.
    5. Upon completion of work, replace failed lamps
    6. Align luminaires and clean lenses and diffusers of paint splatters, dirt and debris.
    7. See Data, Communications, and Alarm Diagram.

END SECTION 26 56 00